

CLAIMS

We claim:

1 ✓ A composition comprising a cationic salt of a weak acid, where the composition is
2 metal atom or ion free and free of heteroatoms, except O or O and S and has volatile
3 combustion products.

1 2. The composition of claim 1, wherein the weak acid is selected from the group
2 consisting of carboxylic acids, phenols, half esters of sulfuric acid, and acidic hydroxy
3 compounds and mixtures and combinations thereof, and the cationic counterion is selected
4 from the group consisting of oxonium ions, sulfonium ions, sulfoxonium ions and mixtures
5 and combinations thereof.

1 3. The composition of claim 1, wherein the weak acid is selected from the group
2 consisting of carboxylic acids and acidic hydroxy compounds and mixtures and combinations
3 thereof, and the cationic counterion is selected from the group consisting of sulfonium ions,
4 sulfoxonium ions and mixtures and combinations thereof.

1 4. The composition of claim 3, wherein the carboxylic acid is selected from the group
2 consisting of mono-, oligo-, or polycarboxy alkanes, alkenes, or alkynes, mono-, oligo- or
3 polycarboxy cycloalkanes, cycloalkene, cycloalkynes, mono-, oligo-, or polycarboxy
4 aromatics, heteroatom-containing analogs thereof, where the heteroatoms are O and/or S, or
5 mixtures or combinations thereof; wherein the sulfonium ions are selected from the group
6 consisting of R,R',R"-sulfonium ions, where R, R' and R" are the same or different alkyl
7 group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon
8 atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7
9 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or
10 mixtures or combinations thereof; and wherein the sulfoxonium ions are selected from the

11 group consisting of R,R',R"-sulfoxonium ions, where R, R' and R" are the same or different
12 alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30
13 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having
14 from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group,
15 or mixtures or combinations thereof.

1 5. The composition of claim 3, wherein the acidic hydroxy compounds include, without
2 limitation, mono-, oligo-, or polyhydroxy alkanes, alkenes or alkynes, mono- or polyhydroxy
3 cycloalkanes, cycloalkene, cycloalkynes, or aromatics and heteroatom-containing analogs,
4 where the heteroatoms are O and/or S, or mixtures or combinations thereof; wherein the
5 sulfonium ions are selected from the group consisting of R,R',R"-sulfonium ions, where R,
6 R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl
7 group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30
8 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol
9 group, a polyalkyleneoxide group, or mixtures or combinations thereof; and wherein the
10 sulfoxonium ions are selected from the group consisting of R,R',R"-sulfoxonium ions, where
11 R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms,
12 aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30
13 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol
14 group, a polyalkyleneoxide group, or mixtures or combinations thereof.

1 6. The composition of claim 1, wherein the weak acid is selected from the group
2 consisting of diethylmalonic acid, 1,2,3,4-butane tetracarboxylic acid, 3-hydroxy-2-methyl-4-
3 pyrone, 4-hydroxy benzoic, carbonic acid, and cis-1,2,3,4,5,6-cyclohexyl hexacarboxylic
4 acid; wherein the cation is selected from the group consisting of trimethylsulfonium ion,
5 triethylsulfonium ion, tripropylsulfonium ion and tributylsulfonium ion.

1 A buffer composition for use in analytical systems having gas-phase or vapor-phase

2 element-specific detectors (ESDs), where the composition comprises a compound comprising
3 a cationic salt of a weak acid, where the composition is metal-atom-free and free of
4 heteroatoms, except O and/or S and has volatile combustion products.

1 8. The composition of claim 7, comprising at least two compounds and covering a
2 desired pH range between about 1 and about 13.

1 9. The composition of claim 7, wherein the weak acid is selected from the group
2 consisting of carboxylic acids, phenols, half esters of sulfuric acid, and acidic hydroxy
3 compounds and mixtures and combinations thereof, and the cationic counterion is selected
4 from the group consisting of oxonium ions, sulfonium ions, sulfoxonium ions and mixtures
5 and combinations thereof.
6
7
8
9
10
11

1 10. The composition of claim 7, wherein the weak acid is selected from the group
2 consisting of carboxylic acids and acidic hydroxy compounds and mixtures and combinations
3 thereof, and the cationic counterion is selected from the group consisting of sulfonium ions,
4 sulfoxonium ions and mixtures and combinations thereof.

1 11. The composition of claim 9, wherein the carboxylic acid is selected from the group
2 consisting of mono-, oligo-, or polycarboxy alkanes, alkenes, or alkynes, mono-, oligo- or
3 polycarboxy cycloalkanes, cycloalkene, cycloalkynes, mono-, oligo-, or polycarboxy
4 aromatics, heteroatom-containing analogs thereof, where the heteroatoms are O and/or S, or
5 mixtures or combinations thereof; wherein the sulfonium ions are selected from the group
6 consisting of R,R',R"-sulfonium ions, where R, R' and R" are the same or different alkyl
7 group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon
8 atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7
9 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or
10 mixtures or combinations thereof; and wherein the sulfoxonium ions are selected from the

11 group consisting of R,R',R"-sulfoxonium ions, where R, R' and R" are the same or different
12 alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30
13 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having
14 from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group,
15 or mixtures or combinations thereof.

1 12. The composition of claim 9, wherein the acidic hydroxy compounds include, without
2 limitation, mono-, oligo-, or polyhydroxy alkanes, alkenes or alkynes, mono- or polyhydroxy
3 cycloalkanes, cycloalkene, cycloalkynes, or aromatics and heteroatom-containing analogs,
4 where the heteroatoms are O and/or S, or mixtures or combinations thereof; wherein the
5 sulfonium ions are selected from the group consisting of R,R',R"-sulfonium ions, where R,
6 R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl
7 group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30
8 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol
9 group, a polyalkyleneoxide group, or mixtures or combinations thereof; and wherein the
10 sulfoxonium ions are selected from the group consisting of R,R',R"-sulfoxonium ions, where
11 R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms,
12 aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30
13 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol
14 group, a polyalkyleneoxide group, or mixtures or combinations thereof.

TOP SECRET - ESTHER 2017

1 13. The composition of claim 9, wherein the weak acid is selected from the group
2 consisting of diethylmalonic acid, 1,2,3,4-butane tetracarboxylic acid, 3-hydroxy-2-methyl-4-
3 pyrone, 4-hydroxy benzoic, carbonic acid, and cis-1,2,3,4,5,6-cyclohexyl hexacarboxylic
4 acid; wherein the cation is selected from the group consisting of trimethylsulfonium ion,
5 triethylsulfonium ion, tripropylsulfonium ion and tributylsulfonium ion.

1 14. An analytical system for detecting an analyte containing heteroatom other than O

2 and/or S comprising:

3 a combustion zone where an analyte and a buffer composition are converted to their
4 corresponding volatile combustion products; and

5 a detector capable of detecting at least one of the corresponding volatile combustion
6 products of the analyte,

7 where the buffer composition comprises a compound comprising a cationic salt of a
8 weak acid, where the composition is metal-atom-free and free of heteroatoms, except O
9 and/or S and has volatile combustion products.

1 15. The system of claim 14, further comprising:

2 a analytical separation apparatus selected from the group consisting of a
3 chromatographic separation apparatus, an electrophoretic separation apparatus, and an
4 extractive separation apparatus or a flow-injection apparatus.

1 16. The system of claim 14, wherein the detector comprises an element-specific-detector.

1 17. The system of claim 16, wherein the element-specific detectors include nitrogen-
2 selective gas-phase chemiluminescence detectors, sulfur-selective gas-phase
3 chemiluminescence detectors, nitrogen-phosphorus thermoionic detectors, electron-capture
4 detectors, atomic emission plasma detectors, or inductively-coupled plasma-mass
5 spectrometric (ICP-MS) detectors.

1 18. The system of claim 14, further comprising a transformation zone where at least one
2 volatile combustion product of the sample is converted into a transformate and a detector
3 capable of detecting at least one transformate.

1 19. A method comprising the steps of combusting a sample and a buffer composition to
2 their corresponding volatile combustion products in a combustion zone and detecting at least

3 one sample volatile combustion products in a detector, where the buffer composition
4 comprises a compound comprising a cationic salt of a weak acid, where the buffer
5 composition is metal-atom-free and free of heteroatoms, except O and/or S and has volatile
6 combustion products.

1 20. The method of claim 19, further comprising the step of mixing the sample and the
2 buffer composition prior to combustion.

1 21. The method of claim 19, further comprising the step of converting at least one volatile
2 combustion product of the sample into at least one transformate and detecting at least one of
3 the transformates.

40022453.121704